

# International Society of Blood Transfusion Committee on Terminology for Red Blood Cell Surface Antigens: Macao report

G. Daniels,<sup>1</sup> L. Castilho,<sup>2</sup> W. A. Flegel,<sup>3</sup> A. Fletcher,<sup>4</sup> G. Garratty,<sup>5</sup> C. Levene,<sup>6</sup> C. Lomas-Francis,<sup>7</sup> J. M. Moulds,<sup>8</sup> J. J. Moulds,<sup>8</sup> M. L. Olsson,<sup>9</sup> M. Overbeeke,<sup>10</sup> J. Poole,<sup>1</sup> M. E. Reid,<sup>7</sup> P. Rouger,<sup>11</sup> E. van der Schoot,<sup>12</sup> M. Scott,<sup>1</sup> P. Sistonen,<sup>13</sup> E. Smart,<sup>14</sup> J. R. Storry,<sup>9</sup> Y. Tani,<sup>15</sup> L.-C. Yu,<sup>16</sup> S. Wendel,<sup>17</sup> C. Westhoff,<sup>18</sup> V. Yahalom<sup>19</sup> & T. Zelinski<sup>20</sup>

<sup>1</sup>Bristol Institute for Transfusion Sciences and The International Blood Group Reference Laboratory, NHS Blood and Transplant, Filton, Bristol, UK

<sup>2</sup>University of Campinas/Hemocentro, Campinas, Brazil

<sup>3</sup>University Hospital, Ulm, Germany

<sup>4</sup>Growing Your Knowledge, Split Junction, NSW, Australia

<sup>5</sup>American Red Cross Blood Services, Pomona, CA, USA

<sup>6</sup>Reference Laboratory for Immunohematology and Blood Groups, Blood Services Center, Magen David Adom, Israel

<sup>7</sup>New York Blood Center, New York, NY, USA

<sup>8</sup>LifeShare Blood Centers, Shreveport, LA, USA

<sup>9</sup>Department of Laboratory Medicine, Lund University and Blood Centre, Lund, Sweden

<sup>10</sup>Sanquin Blood Supply, Diagnostic Services, Amsterdam, The Netherlands

<sup>11</sup>Centre national de Référence pour les Groupes sanguines, Paris, France

<sup>12</sup>Sanquin Research at CLB, Amsterdam, The Netherlands

<sup>13</sup>Finnish Red Cross Blood Transfusion Service, Helsinki, Finland

<sup>14</sup>Durban, South Africa

<sup>15</sup>Osaka Red Cross Blood Center, Osaka, Japan

<sup>16</sup>Mackay Memorial Hospital and National Taiwan University, Taipei, Taiwan

<sup>17</sup>Blood Bank, Hospital Sirio-Libanês, São Paulo, Brazil

<sup>18</sup>American Red Cross and the University of Pennsylvania, Philadelphia, PA, USA

<sup>19</sup>National Blood Group Reference Laboratory, Magen David Adom, Ramat Gan, Israel

<sup>20</sup>Rh Laboratory, Winnipeg, Manitoba, Canada

## Vox Sanguinis

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The committee met in Macao Special Administrative Region, China, during the 2008 International Society of Blood Transfusion (ISBT) Congress. Some changes to the classification documented in Blood Group Terminology 2004 [1] and updated in 2007 [2] were agreed and are described below. The full

updated classification can be found on the blood group terminology website at <http://www.blood.co.uk/ibgri>. A new blood group system, the RHAG system, was established and new antigens were added to the Rh, Kell, and Dombrock systems (Table 1). A total of 308 antigens are now recognized, 270 of which are clustered in 30 blood group systems.

*Correspondence:* Geoff Daniels, Bristol Institute for Transfusion Sciences, NHS Blood and Transplant, North Bristol Park, Northway, Filton, Bristol BS34 7QH, UK  
E-mail: [geoff.daniels@nbs.nhs.uk](mailto:geoff.daniels@nbs.nhs.uk)

### System 4: Rh

One high-incidence antigen has been added to the Rh system. RH57 (CEST) is antithetical to the low-incidence antigen

**Table 1** New blood group antigens

Number	Symbol	Incidence	Molecular basis <sup>1</sup>		Reference
			Common	variant	
RH57	CEST	High	<i>RHCE</i> 340C>T	R114W	[3]
KEL32	KUCI	High	<i>KEL</i> 1271C>T	A424V	[4]
KEL33	KANT	High	<i>KEL</i> 1283G>T	R428L	[4]
KEL34	KASH	High	<i>KEL</i> 758 A>G	Y253C	
DO6	DOYA	High	<i>ART</i> 4547 T>G	Y183D	[5]
RHAG1	Duclos	High	<i>RHAG</i> 316C>G	Q106E	[8]
RHAG2	OI <sup>a</sup>	Low	<i>RHAG</i> 680C>T	S227L	[8]
RHAG3 <sup>2</sup>	DSLK	High	<i>RHAG</i> 490 A>C	K164Q	[8]

<sup>1</sup>Numbers for nucleotide and amino acid location, counting from A of initiating methionine codon and that methionine residue, respectively.

<sup>2</sup>Provisional assignment.

RH48 (JAL) and is defined by an antibody produced by an RH:48,-57 patient who is homozygous for an *RHCE* allele encoding RH48 and an Arg114Trp substitution in the RhCcEe protein [3] (Table 1).

### System 6: Kell

Three antigens of high incidence were added to the Kell system: KEL32 (KUCI), KEL33 (KANT) and KEL34 (KASH). Antibodies defining these antigens were non-reactive with K<sub>0</sub> (Kell-null) red blood cells.

The KEL:-32 proposita and her KEL:-32 sister are heterozygous for a *KEL* allele encoding Ala424Val. No cause for the apparent silencing of the *KEL* gene *in trans* was found [4]. Anti-KEL33 was produced in an individual heterozygous for a *KEL* allele encoding Arg428Leu and for a known *KEL*\*O allele [4]. KEL:-32 red blood cells are also KEL:-33, but KEL:-33 cells are KEL:32. The antibody defining KEL34 (KASH) is non-reactive with the red blood cells of the antibody maker and with those of her sister. Both the KEL:-34 propositus and her KEL:-34 sister have a K<sub>mod</sub> phenotype and are homozygous for a *KEL* allele encoding a Tyr253Cys substitution (Poole J, Karamatic Crew, V, unpublished observations).

### System 14: Dombrock

DO6 (DOYA) is defined by an antibody to a high-incidence antigen produced in a patient who was homozygous for *DO*\*1 (793A) and for a novel *DO* mutation encoding Tyr183Asp (Table 1). The red blood cells of the antibody maker are DO:-1,-2 with weakened expression of DO3, DO4, and DO5. Anti-DO6 reacts with red blood cells of

common Dombrock type, but weakly with DO:-4 (Hy-) and DO:-5 [Jo(a-)] red blood cells, and is non-reactive with DO:-3 [Gy(a-)] cells [5].

### System 30: RHAG

RHAG is a new blood group system comprising three antigens, one of which is assigned provisionally. Antigens of this system appear to be located on the Rh-associated glycoprotein (CD241) encoded by the *RHAG* gene [6].

RHAG1 (Duclos) was previously the high-incidence antigen 901013. The antibody defining RHAG1 (Duclos) reacts with all red blood cells apart from those of the antibody maker and those Rh<sub>null</sub> red blood cells that lack MNS5 (U) [7]. The antibody maker, whose red blood cells had normal Rh antigens and slightly weakened MNS5 [8], was homozygous for 316C>G in *RHAG* encoding Gln106Glu (Table 1). HEK293 cells expressing normal *RHAG* reacted with anti-RHAG1, whereas those expressing *RHAG* containing 316C>G did not [8].

RHAG2 (OI<sup>a</sup>) was previously the low-incidence antigen 700043. The original family study showed that RHAG2 expression is associated with weakened expression of Rh antigens, but that the gene governing RHAG2 is not located at the Rh locus [9]. Two RHAG:2 members of the original family are heterozygous for a nucleotide change in *RHAG* encoding Ser227Leu close to the fourth predicted loop of the Rh-associated glycoprotein [8]. In addition, red blood cells of a Japanese individual with the Rh<sub>mod</sub> phenotype and homozygous for the Ser227Leu mutation [10] were subsequently shown to be OI(a+) (Tilley L, Poole J, Daniels G, unpublished observations).

RHAG3 (DSLK) is a high-incidence antigen defined by an antibody with reactivity characteristics similar to those of anti-RHAG1 (non-reactive with Rh<sub>null</sub> MNS:-5 cells, reactive with Rh<sub>null</sub> MNS:5 cells), but the red blood cells of the RHAG:-3 antibody maker were RHAG:1. This RHAG:-3 patient was homozygous for a mutation in *RHAG* encoding Lys164Gln [8]. Owing to incomplete evidence, RHAG3 is provisionally assigned to the RHAG system. DSLK was initially named DL [8], but changed to DSLK (from letters in 'Duclos-like') to comply with the rule that symbols for designating new specificities will consist of three to six on-line, capital letters [1].

### 700 series

700043 (OI<sup>a</sup>) has been assigned RHAG2 and is now obsolete.

### 901 series

901013 (Duclos) has been assigned RHAG1 and is now obsolete.

## Superscripts and subscripts

Many of the traditional symbols for blood group antigens and phenotypes incorporate superscripts and subscripts. In circumstances where superscripts and subscripts are not available, the superscript or subscript should be written on the line. For example, Jk<sup>a</sup> would be Jka.

## Future considerations

Work is continuing on the establishment of a terminology for blood group alleles and on the development of a new collection containing antigens on glycoprotein A that are determined primarily by glycosylation, including Hu, M<sub>1</sub>, Tm, Sj and Can.

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## Appendix 1. Members of the committee

Dr GL Daniels (Chair): Bristol Institute for Transfusion Sciences, NHS Blood and Transplant, Filton, Bristol, UK. [geoff.daniels@nbs.nhs.uk](mailto:geoff.daniels@nbs.nhs.uk)

Prof Dr L. Castilho: University of Campinas/Hemocentro, Campinas, Brazil. [castilho@unicamp.br](mailto:castilho@unicamp.br)

Prof WA Flegel: University Hospital, Ulm, Germany. [willy.flegel@uni-ulm.de](mailto:willy.flegel@uni-ulm.de)

Prof G Garratty: American Red Cross Blood Services, Southern California Region, Pomona, CA, USA. [garratty@usa.redcross.org](mailto:garratty@usa.redcross.org)

Ms C Lomas-Francis: New York Blood Center, New York, NY, USA. [clomas-francis@nybloodcentre.org](mailto:clomas-francis@nybloodcentre.org)

Mr JJ Moulds: LifeShare Blood Centers, Shreveport, LA, USA. [jjmoulds@lifeshare.org](mailto:jjmoulds@lifeshare.org)

Dr JM Moulds: LifeShare Blood Centers, Shreveport, LA, USA. [jmmoulds@lifeshare.org](mailto:jmmoulds@lifeshare.org)

Prof ML Olsson: Blood Centre, University Hospital, Lund, Sweden. [Martin\\_1.Olsson@med.lu.se](mailto:Martin_1.Olsson@med.lu.se)

Dr MAM Overbeeke: Sanquin Blood Supply, Diagnostic Services, Amsterdam, the Netherlands. [m.overbeeke@sanquin.nl](mailto:m.overbeeke@sanquin.nl)

Ms J Poole: IBGRL, NHS Blood and Transplant, Filton, Bristol, UK. [joyce.poole@nbs.nhs.uk](mailto:joyce.poole@nbs.nhs.uk)

Dr ME Reid: New York Blood Center, New York, NY, USA. [mreid@nybloodcentre.org](mailto:mreid@nybloodcentre.org)

Prof Ph Rouger: Centre national de Référence pour les Groupes sanguins, Paris, France. [tcb\\_ints@ints.fr](mailto:tcb_ints@ints.fr)

Prof CE van der Schoot: Sanquin Research at CLB, Amsterdam, the Netherlands. [e.vanderschoot@sanquin.nl](mailto:e.vanderschoot@sanquin.nl)

Prof M Scott: Bristol Institute for Transfusion Sciences, NHS Blood and Transplant, Filton, Bristol, UK. [marion.scott@nbs.nhs.uk](mailto:marion.scott@nbs.nhs.uk)

Dr P Sistonen: Finnish Red Cross Blood Transfusion Service, Helsinki, Finland. [pertti.sistonen@bts.redcross.fi](mailto:pertti.sistonen@bts.redcross.fi)

Mrs E Smart: Durban, South Africa. [eapsmart@svnet.co.za](mailto:eapsmart@svnet.co.za)

Dr JR Storry: Blood Centre, University Hospital, Lund, Sweden. [jill.storry@med.lu.se](mailto:jill.storry@med.lu.se)

Dr Y Tani: Osaka Red Cross Blood Center, Osaka, Japan.  
taniy@sannet.ne.jp

Dr LC Yu: Mackay Memorial Hospital and National Taiwan  
University, Taipei, Taiwan. yulc@ntu.edu.tw

Dr S Wendel: Blood Bank, Hospital Sirio-Libanês, São  
Paulo, Brazil. snwendel@uninet.com.br

Dr CM Westhoff: American Red Cross and the University

of Pennsylvania, Philadelphia, PA, USA. westhoff@usa.  
redcross.org

Dr V Yahalom: NBGRL Magen David Adom, Ramat Gan,  
Israel. veredy@mdais.co.il

Dr T Zelinski: Rh Laboratory, Winnipeg, Manitoba,  
Canada. zelinski@ms.umanitoba.ca